TORREYA

August, 1911

Vol. 11 No. 8

SEED WEIGHT IN STAPHYLEA AND CLADRASTIS

By J. Arthur Harris

In an interesting paper on light and heavy seeds in cereals Waldron* concludes that in oats, plants with shorter culms, shorter heads, and a smaller number of grains per head bear on the whole grains of greater weight. Waldron's interest in the problem was that of the plant breeder, concerned in determining the results of selecting large or small seeds for planting, but they seem suggestive for the physiologist as well.

The explanation which the physiologist would at once suggest is that the competition of an abnormally large number of seeds for the available plastic material has, as a necessary result, a limitation of the size of the individual seeds. While this seems a very reasonable interpretation, one who has had experience in the actual study of such phenomena will hesitate in accepting it without further evidence. The discrimination and measurement of the individual factors underlying such functions as fertility and seed weight is an exceedingly difficult problem. As an example, take the following case. If the seeds are smaller in the larger inflorescences of Waldron's cereals because of the finer partition of the available plastic material, one would *a priori* expect that there would generally be a negative correlation between the number of fruits per inflorescence and the number of seeds which these fruits produce. So far as observations are available this is not the case.

For a series of the climbing bitter sweet, *Celastrus scandens*,† the correlations are:

* Waldron, L. R. A Suggestion regarding Heavy and Light Seed Grain. Amer. Nat. 44: 48–56. 1910.

† Ann. Rept. Mo. Bot. Gard. 20: 116–122. 1909.

[No. 7, Vol. II, of Torreya, comprising pp. 145–164, was issued 19 July 1911.]

Flowers formed per inflorescence and seeds developing per fruit,

$$r = .033 \pm .013.$$

Fruits maturing per inflorescence and seeds developing per fruit,

$$r = -.012 \pm .013.$$

For large series of *Staphylea trifolia* from the Missouri Botanical Garden the correlations have been determined both between number of fruits developing per inflorescence and number of seeds maturing per locule and between position of fruit on the inflorescence axis and number of seeds maturing per locule. The same relationships for the ovules per locule are available for comparison.* Table I. shows how slender the relationships are.

TABLE I

Character of Inflorescence	Character of Fruit	
	Seeds per Locule	Ovules per Locule
Number of fruits per inflorescence:		
General sample, 1906, 2,059 fruits..	$-.0474 \pm .0086$	$+.0391 \pm .0086$
General sample, 1908, 4,033 fruits..	$-.0494 \pm .0061$	$+.0633 \pm .0061$
General sample, 1909, 2,082 fruits..	$+.0626 \pm .0085$	$-.0539 \pm .0085$
Mean for 20 individual shrubs of 1906 series.....	$-.0399 \pm .0080$	$+.0192 \pm .0185$
Position of fruit on inflorescence:		
General sample, 1906, 2,059 fruits..	$-.0148 \pm .0086$	$-.0501 \pm .0086$
General sample, 1908, 4,033 fruits..	$-.0077 \pm .0061$	$-.0519 \pm .0061$
General sample, 1909, 2,083 fruits..	$+.0128 \pm .0085$	$-.0895 \pm .0085$
Mean for 20 individual shrubs of 1906 series.....	$-.0310 \pm .0088$	$-.0733 \pm .0177$

A comparison of these results shows how great caution should be used in discussing the factors underlying seed development, and how urgently further quantitative data are needed. The accumulation of such data necessarily proceeds slowly and the cooperation of many workers is desirable. The purpose of this

* The data upon which all these constants are based, with discussions of their significance, are to be found in three papers by the writer of this note: Further Observations on the Selective Elimination of Ovaries in *Staphylea*. Zeitschrift f. Ind. Abst- u. Vererbungslehre 5: 173–188. 1911. Observations on the Physiology of Seed Development in *Staphylea*. Beihefte z. Bot. Centralbl. In press. The Influence of the Seed upon the Size of the Fruit in *Staphylea*. Bot. Gaz. In press.

note is to put on record the results of a couple of series of weighings which seem of interest in this connection.

The pods of the American bladder nut, *Staphylea trifolia*, are characterized by the production of few seeds. In a large series of countings it will be found that the great majority of fruits produce one or two seeds only; those with more than six are very rare. This is shown in Table II. for 4,024 fruits collected

TABLE II

Total Seeds per Fruit	Number of Fruits	Total Seeds per Fruit	Number of Fruits
0	4	8	16
1	1,585	9	9
2	1,240	10	5
3	637	11	2
4	310	12	1
5	125	13	—
6	59	14	—
7	30	15	1

from eleven shrubs in the North American Tract of the Missouri Botanical Garden in the fall of 1905. The polygon is very skew, the pronounced mode being a single seed while the frequencies fall off rapidly as the number of seeds become larger. In the collections from individual shrubs the empirical mode is sometimes on two instead of one, but the conspicuous skewness is a feature of all of the several series of *Staphylea* fruits hitherto examined. The same skewness is observed in Table III. for number of seeds per locule (of which there are three per fruit).

TABLE III

Seeds per Locule	Number of Locules	Seeds per Locule	Number of Locules
0	5,684	4	72
1	4,593	5	19
2	1,387	6	4
3	313		

I have been able to study fruits from only a single tree of the yellow wood, *Cladrastis tinctoria*, in the Arboretum of the Missouri Botanical Garden. Possibly because of its isolation, the fruiting of this individual is not typical of the species, but in

the 2,128 pods examined to determine the number of seeds developing (Table IV.) one notes a skewness of distribution similar to that in *Staphylea*.

TABLE IV

Seeds per Pod	Number of Pods	Seeds per Pod	Number ot Pods
1	1,423	4	25
2	560	5	4
3	116		

Now it seems of interest to determine whether (in fruits which produce on an average so few seeds and among which those producing several are very rare) the weight of the individual seeds is in any degree dependent upon the number formed in the fruit.

The seeds of *Staphylea* are particularly suited to work of this kind. They are hard, smooth and clean; seeds which have an imperfect development—so far as can be ascertained by external examination—are exceedingly rare. *Cladrastis* seeds are not so suitable for weighing. Here as in many Leguminosae ovules which have failed to mature completely are sometimes found. All apparently blighted seeds were picked out before the weighings were made and we are consequently dealing with a sample of apparently sound seeds. The discarding of these should not vitiate the results.

TABLE V

Total Seeds per Fruit	Number of Seeds Weighed	Mean Weight	Total Seeds per Fruit	Number of Seeds Weighed	Mean Weight
1	150	.05978	5	150	.05265
2	150	.05988	6	150	.05145
3	150	.05662	7	100	.05377
4	150	.05353	8	50	.04680

Table V. shows the average weight of seeds of *Staphylea* from pods with different numbers of seeds per pod. The material is that of the fall of 1905. The results here seem to show very clearly that the difference between the weight of seeds produced in pods maturing one and two seeds is not very great, but when more than this number are developed the weight of the seed materially decreases.

In *Cladrastis* the seeds were classified not merely according to the number produced in the pod, but according to their position in the pod, the positions being numbered from the proximal to the distal end. Table VI. gives the results. When only one seed is produced the mean weight is higher than when the pod contains two or more. There is no essential difference between 2- and 3-seeded pods. Within a pod containing 2–4 seeds the mean weight decreases from the proximal towards the distal position.

TABLE VI

Seeds per Pod	Position of Seed in Pod				
	1	2	3	4	All
1	($N=500$) .03385				($N=500$) .03385
2	($N=500$) .03267	($N=500$) .03134			($N=1000$) .03201
3	($N=100$) .03257	($N=100$) .03183 .	($N=100$) .03163		($N=300$) .03201
4	($N=22$) .03209	($N=22$) .03086	($N=22$) .03013	($N=22$) .02945	($N=88$) .03064

The weights could not be determined for the seeds individually to allow of obtaining the probable errors which are much needed where differences so slight as those given here are involved. They were weighed in groups of 25, and when these individual samples from different kinds of pods or positions are compared, the results emphasize the general trustworthiness of the conclusions drawn above.

The exact degree of interdependence between number of seeds per pod or position of the seed in the pod and seed weight cannot be determined from this series of data since the variability in seed weight is unknown.* It is evident, however, that in the absolute size of seed only very slight (although definite) differences are referable to characteristics of the pod. I think that *a priori* physiologists would have expected greater differences.

COLD SPRING HARBOR, L. I.,
July 14, 1911.

* Data for another species in which this point has been determined are now in hand.